

W-rich metal in an unbrecciated eucrite: Mineralogical record of late veneer

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The Late Veneer Hypothesis suggests that terrestrial planets and differentiated asteroids accreted chondritic materials after the metal-silicate segregation. The addition of these chondritic materials is of great significance for understanding the early evolution of terrestrial planets and differentiated asteroids. This hypothesis was originally proposed based on the overabundance and approximately chondritic pattern of highly siderophile elements in the silicate Earth and has been widely applied to other terrestrial planets and differentiated planetesimals. However, no mineralogical records have been reported yet. The present paper reports that a sulfide grain in the unbrecciated eucrite Northwest Africa 8326 that crystallized at 4559 million years ago contains a W-rich metal particle approximately 300 nanometers in size. This metal particle also exhibits enrichment in highly siderophile elements Ir, Ru, and Rh. The unique composition of the metal particle cannot be interpreted with the magmatic, metamorphic, and alteration processes in a differentiated body. Instead, the W-rich feature is similar to that of some refractory metals described in chondritic materials that accreted before the formation of differentiated bodies and requires a highly reducing condition for formation and preservation. We suggest that the W-rich metal particle is a residue of a chondritic material that accreted into the parent body of eucrite and somehow survived subsequent processes. If this is the case, the W-rich metal particle in NWA 8326 represents the first mineralogical evidence supporting late veneer during the early evolution of differentiated bodies. Since the W-rich metal is not only enriched in W but also expected to have a unique W isotopic composition, its presence in certain natural samples would have a significant impact on the study of the W isotope model ages of differentiated bodies, which are critical to understanding the timing of core-mantle segregation.